1-19-1979

Tellico Dam and Reservoir: Staff Report to the Endangered Species Committee

Robert K. Davis
United States. Dept. of the Interior

(This document is the Committee's master copy original from which all copies were made.)
See, e.g. page 2.15

Tellico Dam and Reservoir

Staff Report
to the
Endangered Species Committee

January 19, 1979

EXECUTIVE SUMMARY

The Endangered Species Committee has been called upon to deliberate on the case of the Tennessee Valley Authority's (TVA's) Tellico Project and the endangered snail darter (Percina tanasi Etnier). The committee has three options:

1. Grant an exemption with one or more mitigation measures

2. Grant an exemption without mitigation measures

3. Deny an exemption.

The committee may grant the Tellico Project an exemption from section 7 of the Endangered Species Act of 1978 if the committee determines that:

1. There are no reasonable and prudent alternatives to the project; and

2. The benefits of the project clearly outweigh the benefits of alternatives which are consistent with conserving the species or its critical habitat and the project is in the public interest.

If the committee votes for an exemption, the law provides that it must establish whatever reasonable mitigation and enhancement measures are necessary to minimize the adverse effects of the Tellico Project on the snail darter or its critical habitat. The committee has the option of granting an exemption but deciding that there are no reasonable mitigation measures.

The principal alternative to completing the Tellico reservoir is development of the Little Tennessee Valley without the reservoir. This alternative can be adequately described and analyzed for comparison with development of the reservoir. On the evidence, the river development alternative is feasible and commensurate with the reservoir in economic value. This alternative is consistent with conserving the snail darter as it maintains the critical habitat of the species and reestablishes free access by downstream populations to upstream spawning areas by removing the earthen dam from one channel of the river.

EXECUTIVE SUMMARY

The committee staff has identified the economic benefits and costs of reservoir development and river development. The staff can compare but cannot weigh the differences in the measured and unmeasured benefits and costs of alternatives. The staff is unable to justify assigning positive net economic benefits for either of TVA's proposed alternatives when land costs are included. Since alternative uses of project lands in the private sector cannot be ignored, the private opportunity costs of the lands (estimated at $4 million annual equivalent) must be included in the benefit-cost comparison. Measured benefits of the reservoir option are $6.5 million compared to capital and land costs of $7.2 million; river development benefits are $5.1 million compared to capital and land costs of $6.2 million.

Unmeasured benefits of river development (or costs of reservoir development) are based largely on the existence of the snail darter and on the cultural, historical, and archaeological values of the river valley; also unmeasured are the uncompensated costs inherent in the loss of customary fish and wildlife values if reservoir development is pursued. The staff finds that the reservoir, on the other hand, is an amenity in its own right. The creation of jobs and wages income in the region is not counted as a national benefit, but it is important, as much testimony shows. TVA finds the river development alternative superior in total jobs created, but estimates an advantage in total wages in favor of the reservoir alternative.

Many citizens and officials have expressed opinions that the project is in the public interest, but there is also a community of interests that opposes the project. In the final analysis, the committee will have to determine what is in the public interest by weighing all measured and unmeasured benefits and costs and by considering who receives the benefits and who pays the costs.

The staff has reviewed the biology and ecology of the snail darter and finds agreement that it is of a unique evolutionary lineage. The snail darter is distinctive among darters in feeding on snails of the gravel shoals. It derives its ecological value from its distinctive role. The snail darter also has esthetic and scientific

value due primarily to its distinctiveness. It possesses potential educational and recreational value.

The mitigation measures offered for the committee's consideration in the event that it grants an exemption include transplanting the snail darter to two additional sites, monitoring the populations closely, and establishing a hatchery program for propagation of the species. The mitigation measures will cost $280,000 initially and at least $35,000 annually for the foreseeable future. The irreconcilable conflict between the species and the dam is reconfirmed by the conclusion that if the reservoir were developed, it would eliminate the only habitat now known to be suitable to the snail darter. If the transplanted populations survive, which is not certain, they will probably not be genetically the same as if the species had continued to exist in the Little Tennessee River.

Exhibit A summarizes the report's findings with respect to benefits and costs of the project and the river development alternative.

Exhibit A

Summary of Benefits and Costs
(in annual equivalents)

	Reservoir Development	River Development
Measured Economic Benefits*	6.50	5.10
Measured Economic Costs		
Remaining capital costs**	3.19	2.26
Opportunity costs of land†	4.03	4.03
Total	7.22	6.29
Cultural, historical, archaeological values‡	–	positive
Preservation of customary fish and wildlife users‡	–	positive
Reservoir as amenity‡	positive	–
Regional jobs and wages§	no discernible difference	no discernible difference

SOURCE: Based on Chapter 2.

*Measured benefits in agriculture and forestry, hydro power, flood control, recreation, navigation and water supply.
**Annualized capital costs include completion of removel of the dam and have been increased to include operation and maintenance.
†Land costs are based on market value of the land annualized at the private discount rate (10 percent).
‡Based on values of national significance.
§National significance only if income redistribution to the region reflects national policy.

Contents

CHAPTER	PAGE	TITLE
INTRODUCTION	i	
CHAPTER 1		REASONABLE AND PRUDENT ALTERNATIVES TO THE PROJECT
CHAPTER 2		BENEFITS AND COSTS OF ALTERNATIVES
	2.1	Agriculture and Forestry
	2.3	Power Generation
	2.4	Flood Control
	2.6	Land Enhancement
	2.6	Recreation
	2.8	Navigation, Employment and Income
	2.10	Unmeasured Benefits and Costs
	2.12	Regional Development
	2.13	Capital Costs
	2.14	Opportunity Costs of Project Land
	2.16	Historic Cost
	2.18	Total Net Benefits
CHAPTER 3		CONSISTENT WITH THE PUBLIC INTEREST
CHAPTER 4		THE SNAIL DARTER
	4.1	Biological and Ecological Characteristics of the Snail Darter

4.4 Value of the Snail Darter

CHAPTER 5 IMPACT OF DEVELOPMENT ALTERNATIVES ON THE SNAIL DARTER

5.1 River Development

5.2 Reservoir Development

Exhibits

INTRODUCTION	ii	Regional Location
	iv	Area Plan of Tellico Dam
CHAPTER 2	4.17	Benefit Cost Summary National Economic Development Benefits

INTRODUCTION

The Little Tennessee River originates in the mountains of Georgia and flows through national forest lands of North Carolina into Tennessee, where it converges with the Big Tennessee River near Knoxville. The lower 33 miles of the Little Tennessee flow through a region of low, parallel ridges and gently rolling valleys bounded by the Great Smoky Mountains National Park, the Foothills Parkway, and the Cherokee National Forest (see Exhibit 1). The area includes much of the best farmland in Blount, Loudon, and Monroe counties. The river here is clear and (unlike the upstream portions which have been dammed) free-flowing, and is generally regarded by biologists and sportsman as an outstanding stocked trout stream.

Recently, this area has become the focus of a controversy: completion of the nearly constructed Tellico Dam would destroy the only habitat where the endangered snail darter is known to survive. Specifically, completion of the dam would permanently flood the area, thus obliterating their feeding and spawning areas. Thus, pursuant to the Endangered Species Act, construction of the dam was halted.

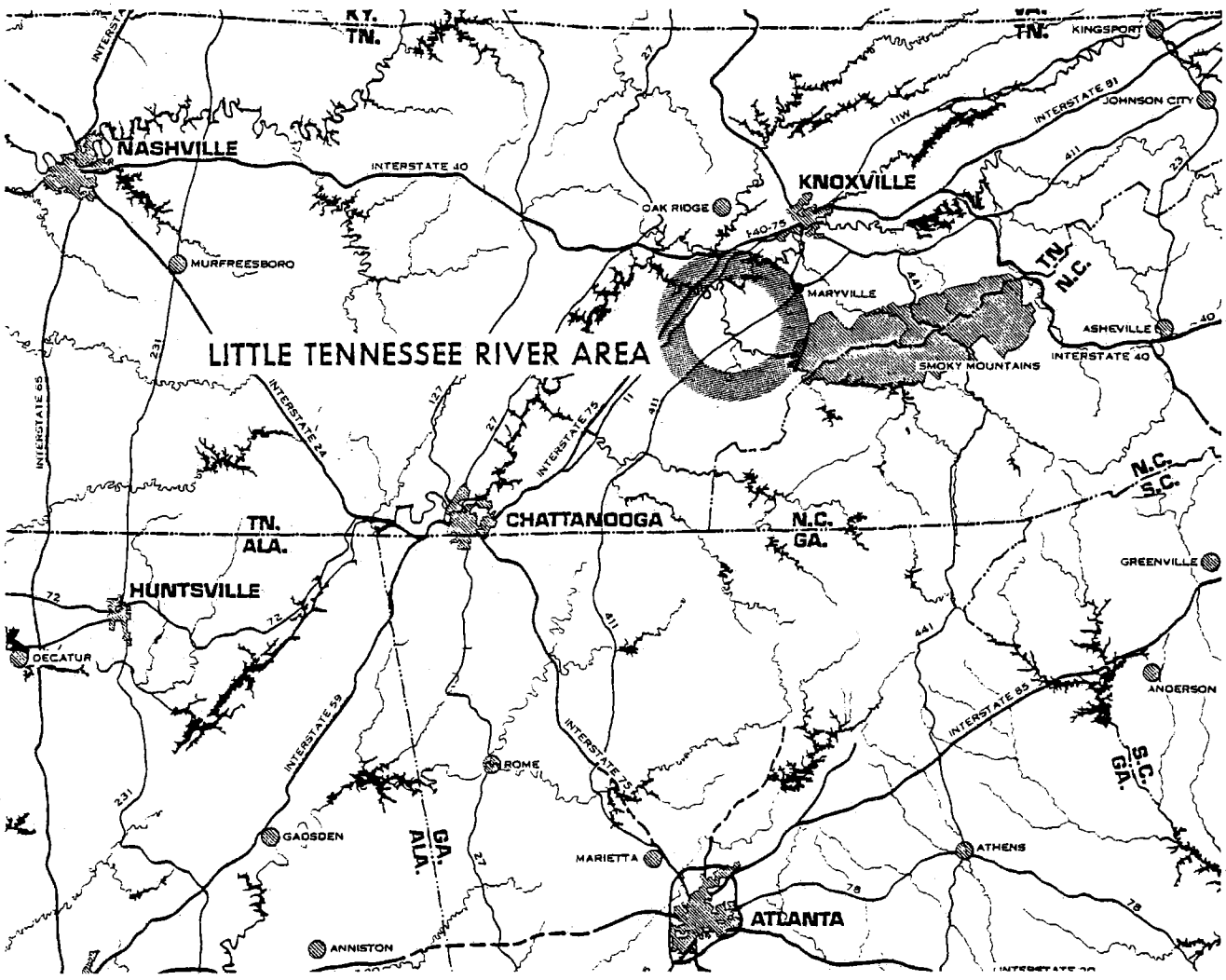
Construction of a dam was first considered in 1936 as a means to counter the high unemployment and out-migration in the area.* In a report to Congress on the unified development of the Tennessee River System, the Tennessee Valley Authority (TVA) stated that a dam and lock located about 4 miles above the mouth of the Little Tennessee might improve navigation. Although this

---

* Some comments reflect continued concern for out-migration and unemployment in the region; however, others note a moderate labor shortage in the area.[1]

Exhibit 1

Regional Location



SOURCE: Tennesee Valley Authority. *Alternatives for Completing the Tellico Project.* 1978.

report concluded that such a project was not feasible at that time, the situation changed several years later:

> A few years later, when Fort Loudoun Dam was being planned on the the Tennessee River just upstream from its confluence with the Little Tennessee, TVA recognized that the flow of the Little Tennessee could be diverted into Fort Loudoun Reservoir by building a dam across the Little Tennessee near its mouth and connecting the two lakes with a canal. In addition to the flexible flood control storage and navigation benefits such a project would provide, water from a Little Tennessee River impoundment would flow through the canal and enable Fort Loudoun Dam to generate additional electricity.[2] (See Exhibit 2)

This "Fort Loudoun Extension" was estimated to cost $10.7 million and, in 1942, Congress made funds available to start construction. The project was interrupted shortly thereafter by World War II, but the Fort Loudoun generators were sized to accommodate the additional flow if the project were to be built in the future.

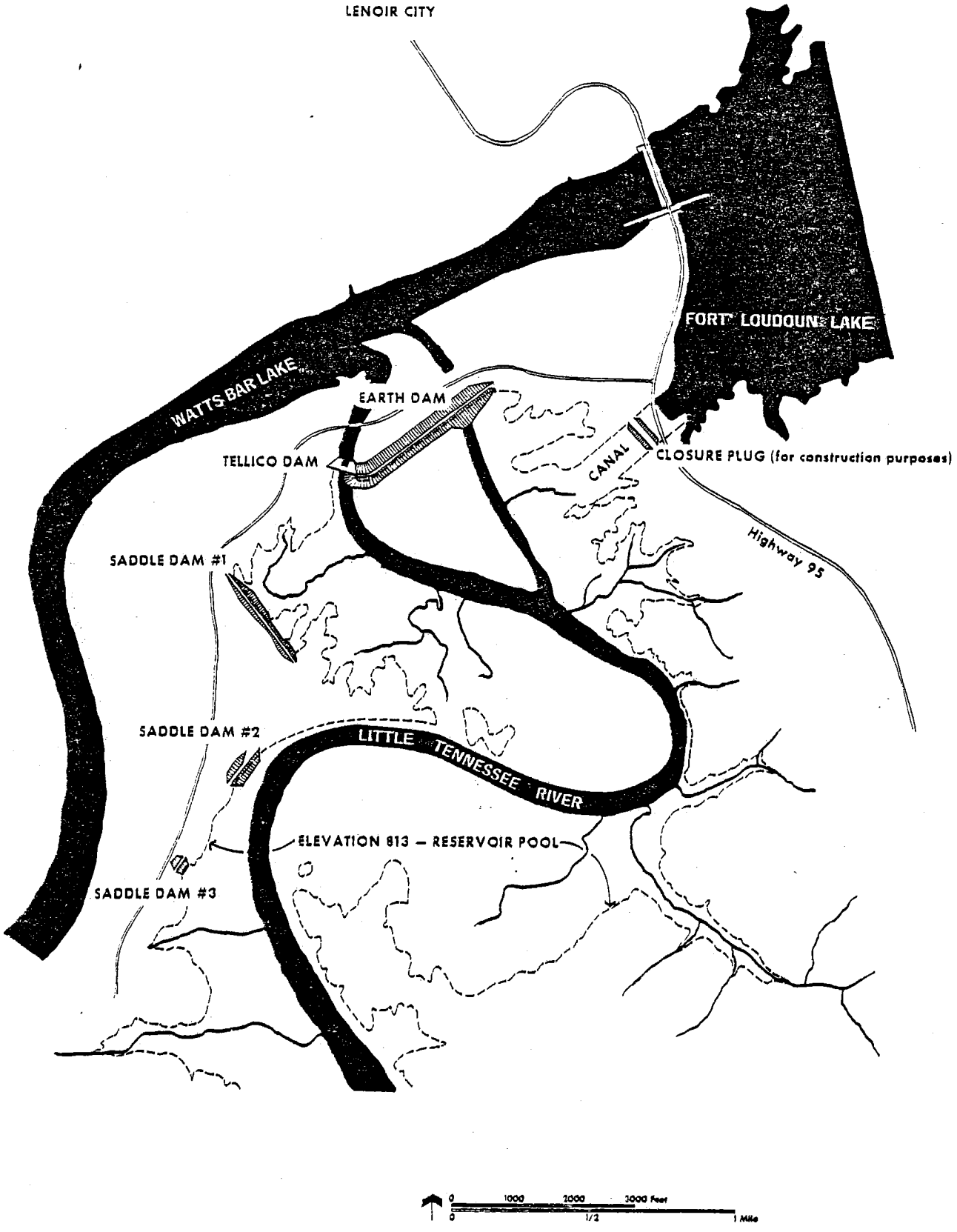
In the succeeding years, TVA concentrated on other projects, and there are now 20 reservoirs within 100 miles of the area in question.[3]

In 1963, the Fort Loudoun Extension was reproposed as the Tellico Project. TVA provides a concise history of Tellico commencing with that date:

> Tellico resembled its predecessor in almost every detail except the TVA, in 1963, proposed to acquire 39,500 acres of land (later revised downward to 38,000), as compared to between 20,000 and 30,000 acres in 1942. TVA said that additional project lands would be available for industrial, commercial, and residential development in a controlled fashion so that the surrounding area could realize the full potential of the project. The estimated project cost was increased to $41 million.

Exhibit 2

Area Plan of Tellico Dam



SOURCE: Tennesee Valley Authority, *Alternatives for Completing the Tellico Project.* 1978.

INTRODUCTION

The Tellico Project was justified by TVA on the basis of a distribution of benefits among recreation (38 percent), shoreline development (19 percent), fish and wildlife enhancement (6 percent), hydroelectric power and navigation (each 11 percent), flood control (13 percent), and water supply (2 percent). TVA also estimated that the project would create some 4,000 industrial jobs and 2,600 trades and service jobs.

Although there was strong support for TVA's development plans in the Tellico area, considerable opposition also had developed. A 1963 staff report by the Tennessee State Planning Commission questioned the wisdom of impounding this stretch of the Little Tennessee River:

> [I]n populous East Tennessee, where reservoirs are already widespread, it might be preferable to reserve one of the few remaining lowland stretches of river containing exceptional cold water fishing potential -- an attraction that might exceed in value those benefits resulting from reservoir impoundment.

On the other hand, then Governor Frank G. Clement of Tennessee said in 1965 [that]

> [I] feel that this [Tellico] project will lend itself to the economic development and the recreational attractiveness of the area where it is proposed.

The Tellico Project was controversial from the very beginning. There was some local support, but at a town meeting in Greenback, Tennessee, in September 1964 there also was a strong expression of opposition to the project by local citizens. The project also attracted national attention when Supreme Court Justice William O. Douglas visited the area in 1965 to express his support of the Eastern Band of the Cherokee Indian Nation, which opposed the project. Both the support and opposition for the project were highly vocal.

INTRODUCTION

> In 1965 and 1966, Congress held hearings on the environmental and economic pros and cons of the project. The proponents and opponents turned out in force. The opposition focused on the natural, historical and cultural value of the river and valley. Primary emphasis was placed on the loss of agricultural land, the Indian culture, and the free flowing river. The proponents, on the other hand, stressed the recreation and economic benefits from the Tellico project. Primary emphasis was placed on the jobs and general economic growth which would be created for an economically depressed area...[In] 1966 [Congress] approved the initial appropriation for the Tellico project and construction begin in 1967. Congress has appropriated funds for Tellico each year thereafter.
>
> * * *
>
> In 1971, a suit was filed in Federal court to halt the project, contending that TVA had not filed an adequate environmental impact statement (EIS) as required by the...National Environmental Policy Act of 1969. TVA contended that NEPA was not applicable to Tellico... The courts held otherwise, and TVA was enjoined from continuing construction of Tellico for 21 months until its final project EIS was ruled acceptable in 1973.
>
> Public opposition to the project during this period included the Honorable Winfield Dunn, Governor of the State of Tennessee, who urged TVA in 1971 to discontinue its plans for the impoundment principally because of the recreational potential of the river in its natural state. TVA rejected the Governor's request for a reappraisal. Two years later, the State of Tennessee presented a recreation plan for the Little Tennessee River Valley at Federal court proceedings concerning the Tellico environmental impact statement. The plan emphasized the unique natural, historical, and cultural values of the area.[4]

Congress first addressed its concern for endangered species in the Endangered Species Act of 1966, and reinforced its concern when it strengthened the law in

1969 and 1973. In 1973, Section 7 was added. This section precludes all federal agencies from authorizing, funding, or carrying out any action that may jeopardize an endangered or threatened species or its habitat.[5]

On August 2, 1971, in comments on the draft EIS, the Tennessee Office of Urban and Federal Affairs, on behalf of the Tennessee Game and Fish Commission, informed TVA that: "Three endangered fish species - log perch, chub and darter -- probably live in lower Citico Creek, lower Tellico Creek, or the Little Tennessee. They could be destroyed by the Tellico impoundment."[6] The Office of Urban and Federal Affairs elaborated upon this warning on September 3, 1971, when it submitted reports on the endangered fish by Dr. David Etnier of the University of Tennessee to TVA. TVA did not, however, address these species in its final EIS submitted on February 10, 1972.[7]

As of January 1972, over $30 million had been spent on the project out of a then-estimated total project cost of $69 million. Land acquisition was 63-percent complete, while road and highway work was 30-percent complete.[8]

TVA's discussion of history continues:

> TVA was notified in March 1975 that the U.S. Fish and Wildlife Service had been petitioned under the Endangered Species Act of 1973 to list as endangered the snail darter, which had been discovered 19 months earlier in the section of the Little Tennessee River to be impounded by Tellico Dam. The fish was listed as endangered in October 1975.
>
> TVA maintained that the act was not applicable to the Tellico Project and for that reason TVA was under no legal obligation to consider any project alternative that would not involve closure of the dam and formation of a reservoir. TVA suggested that this position was at least implicitly supported by Congress through its continued funding of the project.
>
> In Congressional hearings on its budget program for fiscal 1976, TVA summarized its position:

INTRODUCTION

> [T]hat act, which became law in 1973, certainly requires us to do what we can to preserve endangered species. But it does not repeal prior congressional approval and funding of the Tellico Project, or any other lawfully, congressional authorized project, because the habitat or range of an endangered species will necessarily be destroyed, altered, or curtailed by the completion of the project ...while we will do our best to preserve the darter if it in fact proves to be a distinct species and is listed as endangered, the project should be completed in any event...

On February 18, 1976, Hill v. Tennessee Valley Authority was filed in Federal District Court to enjoin the Tellico Project as being in violation of the Endangered Species Act. Trial was held in April and the court dismissed the case on its merits a month later. Plaintiffs appealed the case to the Sixth Circuit Court of Appeals in July and the court issued an injunction that permitted TVA to continue construction of the project but enjoined closure of the dam. On October 12, 1976, the Department of the Interior (DOI) issued a biological opinion that the continued existence of the snail darter would be jeopardized and its critical habitat destroyed should Tellico Dam be closed. During this period, TVA continued work on construction activities specifically permitted by the injunction.

On January 31, 1977, the Sixth Circuit Court of Appeals reversed the district court decision, holding that TVA was wrong in assuming that the Endangered Species Act did not apply to the Tellico Project. The court prohibited TVA from performing any construction activity which would destroy or modify the fish's critical habitat. At this time, the project was 90 percent complete. The injunction permitted continued work on highways and bridges in the area that would be required whether or not the project was ever completed. TVA fully complied with the injunction.[9]

However, TVA also appealed to the United States Supreme Court, which last June affirmed the decision of the Court of Appeals.[10] The Supreme Court found that "Congress has spoken in the plainest of words, making it abundantly clear that the balance has been struck in favor of affording endangered species the highest of priorities" and that the "plain intent" of Congress was to "halt and reverse the trend toward species extinction, whatever the cost."[11]

In response to the Supreme Court opinion, Congress decided last fall to introduce an element of flexibility into the Endangered Species Act (ESA). In adopting the Endangered Species Act Amendments of 1978 (ESAA), it established the Endangered Species Committee to consider applications for exemptions from the requirements of the Act, under certain specified criteria.[12] Moreover, the Amendments provide for special, accelerated consideration of exemption applications for the Tellico Dam and Reservior Project and the Missouri Basin Power (Grayrocks) Project (MBPP).[13] The committee was required to begin to consider those exemptions within 30 days after the Amendments were enacted and to make decisions in those cases within 90 days after the enactment.[14] If no decision is made within 90 days, the projects are to be deemed exempted.[15]

Under the amended statute, the committee's decision to grant an exemption for the Tellico Project must be based on the following independent criteria:

i. There are no reasonable and prudent alternatives to the proposed agency action; and

ii. The benefits of the proposed agency action clearly outweigh the benefits of alternative courses of action consistent with conserving the snail darter or its critical habitat; and the proposed agency action is in the public interest.[16]

If the criteria are met, the committee is authorized to grant an exemption, provided that it also:

> establishes such reasonable mitigation and enhancement measures, including, but not limited to, live propagation, transplantation, and habitat

> acquisition and improvement, as are necessary and appropriate to minimize the adverse effects of the agency action upon the [snail darter or its] critical habitat...[17]

In other words, the committee could grant an exemption without requiring mitigation measures. If mitigation is required, TVA would bear the costs of the mitigation and enhancement measures and must submit annual reports to the Council on Environmental Quality describing its compliance with the mitigation and enhancement requirements.[18]

If no exemption is granted, the Department of the Interior (DOI) could be expected to proceed with its responsibilities under section 4(g) of ESAA to adopt a recovery plan and proceed with the recovery actions. The costs would probably be borne by TVA, the Tennessee Wildlife Resources Agency, and the Fish and Wildlife Service (FWS).

The views ascribed to DOI in this document represent the views of the Assistant Secretary for Fish and Wildlife and Parks. The information that the committee needs to reach its decision is presented in the following five chapters:

Chapter 1: Reasonable and Prudent Alternatives to the Tellico Dam Project

Chapter 2: Benefits and Costs of the Alternatives

Chapter 3: Consistency with the Public Interest

Chapter 4: The Snail Darter

Chapter 5: Impacts of Development Alternatives on the Snail Darter.

REFERENCES

1. Comment of Rep. John T. Duncan et al; Jan. 2, 1979; comment of William Gary Kilzer of Tennessee Dept. of Employment Security.

2. Tennessee Valley Authority, Alternatives for Completing the Tellico Project (December 1978), p. 4.

3. General Accounting Office, The Tennessee Valley Authority's Tellico Dam Project: Costs, Alternatives, and Benefits (October 1977).

4. TVA, Tellico Project, pp. 4-7.

5. Endangered Species Act of 1973, P.L. 93-205, 87 Stat. 884-903, 16 U.S.C. 1531-1543; Endangered Species Preservation Act of October 15, 1966, P.L. 89-699, 80 Stat. 926; Endangered Species Conservation Act of 1969, P.L. 91-135, 83 Stat. 275.

6. Environmental Impact Statement, Vol. 1, _____.

7. EIS, Vol. 1, pp. 1-3-52, 1-3-56, 1-3-61, 1-3-81, 1-1-27.

8. EIS, Vol. 1, p. 1-1-1.

9. TVA, Tellico Project, p. 7

10. Tennessee Valley Authority v. Hill (No. 76-1701, U.S. Supreme Court decision of June 15, 1978).

11. Slip Opinion at 39, 29.

12. Endangered Species Act Amendments of 1978, P.L. 95-632, 92 Stat. 3758, amending 16 U.S.C. 1536.

13. Sect. 10(i), as amended.

14. Sect. 10(i), as amended.

15. Sect. 10(i), as amended

16. Sect. 10(i)(1) and Sect. 7(h)(1)(A)(i),(ii), as amended.

17. Sect. 7(h)(1)(B), as amended.

18. Sect. 7(1).

CHAPTER 1

REASONABLE AND PRUDENT ALTERNATIVES TO THE PROJECT

The committee must first determine whether or not there are any reasonable and prudent alternatives to the project. The range of alternatives considered by the committee is meant to be quite broad.[1]

"Reasonable and prudent" is not defined by the statute, but the Conference Committee stated that generally only those alternatives "which are both technically capable of being constructed and prudent to implement" need be considered under section 7(h)(1)(A)(i) and (ii).[2] No alternative can be considered "reasonable and prudent" unless it "would avoid jeopardizing the continued existence of any endangered or threatened species or adversely modifying the critical habitat of such species..."[3]

Before 1978, little attention had been paid to nonreservoir alternatives. The General Accounting Office (GAO) stated that:

> In its 1963 Tellico project proposal, TVA neither identified nor evaluated any alternate uses for the project area. According to a TVA official, no comparison of alternatives was made because existing statutes did not require documented comparison, and because TVA's philosophy and experience at that time indicated that a multipurpose reservoir was the best economic stimuli for a depressed area.[4]

In 1972, TVA included an evaluation of project alternatives in its EIS. Of the six alternatives presented, four were smaller variations of the full dam with varying amounts of reservoir pool and scenic stream. The other two were (1) no project and (2) a scenic stream. None of the alternatives was estimated to achieve even 50 percent of the net benefits shown for the project.[5]

REASONABLE AND PRUDENT ALTERNATIVES TO THE PROJECT

In August 1973, the Tennessee Governor's Office issued a plan emphasizing the unique natural, historical, and cultural values of the Little Tennessee Valley. No benefit estimates were included in the state plan.[6]

The GAO report contains an overview of substitute plans that would not pose a threat to the survival of the snail darter. The costs of abandoning the Tellico Project are discussed, as are eight alternative land-use proposals proffered by various individuals and groups.[7] The report includes no specific conclusions on alternatives because the available benefit and cost information was considered inadequate. However, the information reviewed by GAO is incorporated in the current discussion.

In 1978, TVA presented a total of four alternatives in its report Alternatives for Completing the Tellico Project. Two alternatives that were considered in the draft of August 10, 1978, were discarded in the final December 1978 report. One involved constructing a 2,500-acre reservoir on the Tellico River, a tributary of the Little Tennessee, at mile 19. TVA analyzed the tributary reservoir for flood control and hydropower and found it to be infeasible.[8] Some commenters, however, view this option as a reasonable and prudent alternative.[8a]

The other alternative examined and subsequently dropped was the dry-dam alternative -- leaving the reservoir area unflooded but keeping the dam intact and operating it for flood control. Although certain activities would be removed from the flood operation area under this alternative, river development would have been about the same as if the earthen dam had been removed.[9]

TVA has decided that, to realize this option, the spillway of Tellico Dam would have to be altered to allow a larger flood than planned to pass without overtopping the dam. This modification would cost an additional amount, exceeding the value of the flood damages prevented.[10] These extensive alterations would be necessary because the dry dam would lack the interconnection with the Fort Loudoun reservoir and thus could not use the reservoir to alleviate the flow if a larger

flood occurred. According to TVA, the gates needed for the interconnection in the case of the dry-dam alternative would be more costly than the extra spillway capacity.[11] This alternative cannot be eliminated on economic grounds alone, because the extent of additional protection needed can be debated.[12] However, this alternative poses another problem: it is not consistent with conserving the species.

River development with use of the dam for flood control would impede migration of yearlings upstream to spawning areas. There is no assurance that the apron and the sluice boxes can be sufficiently modified to allow fish passage or that mechanical means of transport can be sufficient and reliable enough to assure viability of the Little Tennessee population. River development with use of the dam for flood control is therefore not presently consistent with conserving the species.[13] Some commenters presented this alternative as reasonable and prudent without discussing whether it is consistent with preserving the species.

The December TVA report describes two alternatives: 1) developing the reservoir; and 2) removing part of the dam and developing the river. DOI, in its Views and Recommendations submitted to the committee,[14] suggests postponement of the dam as one alternative and liquidation of the landholdings as another. The committee staff believes that both of these alternatives are subsumed under the more general alternative of river development and therefore do not merit further treatment. Thus, it appears that river development is TVA's feasible and economic alternative to the Tellico dam project.* River development would maintain the critical habitat of the snail darter and partial removal of the dam under this alternative would allow the yearling fish to migrate upstream to spawning areas. The existence of the dam currently prevents this upstream migration.

---

* The staff reasons that if TVA proceeds with river development, the reservoir option can still be reconsidered at a later date. Also, under river development, TVA must contemplate an infinite variety of combinations of public and private ownership, including complete liquidation of its landholdings.

REFERENCES

1. Conference Report on the Endangered Species Act Amendments of 1978, H.R. Rep. 95-1804, 95th Cong., 2d Sess. (1978), p.20.

2. Conference Report, p.20.

3. Endangered Species Act Amendments, sections 7(a); 7(b); 7(g)(5)(A); Conference Report, pp. 21, 20.

4. General Accounting Office, The Tennessee Valley Authority's Tellico Dam Project -- Costs, Alternatives and Benefits, report to Congress (Oct. 14, 1977), p. 15.

5. Environmental Impact Statement.

6. GAO, TVA's Tellico Dam, p. 18.

7. GAO, TVA's Tellico Dam, p. 20.

8. TVA draft report (Aug. 10, 1978), p. 26.

8a. Comments of Michael Bean, Jan. 8, 1979.

9. TVA draft report, p. 27.

10. TVA, Tellico Project, p. i.

11. TVA, Tellico Project, pp. 57-58.

12. TVA, Tellico Project, Appendix A, pp. 138-139.

13. TVA, Tellico Project, Appendix C, pp. 149-150.

14. Department of the Interior, David Hales, Assistant Secretary of the Interior for Fish, Wildlife and Parks, Views and Recommendations to the Endangered Species Committee, letter (January 8, 1979) to the Committee Chairman.

CHAPTER 2

BENEFITS AND COSTS OF ALTERNATIVES

The law specifically requires the committee to weigh the benefits of the proposed action against the benefits of alternatives "which conserve the species or its critical habitat."[1] The staff can compare the alternatives quantitatively and can provide information short of quantification, but only the committee can decide whether one quantity or fact clearly outweighs another.*

In comparing the benefits and costs of the proposed dam development and its alternative river development, the committee must consider the potential benefits to agriculture and forestry; power generation; flood control; land enhancement; recreation; water supply; navigation; income, and employment; unmeasured benefits; and regional development. In addition, the committee must consider capital costs and the opportunity costs of the land. Historic costs are also as a matter of general interest.**

AGRICULTURE AND FORESTRY

A principal difference between the reservoir and river development alternatives lies in the potential benefits to agriculture. Specifically, with river development, 9,705 acres out of the 16,000 acres that would be occupied by the reservoir could be used for agriculture. Development above the normal pool (elevation 813) would permit another 5,600 acres of agriculture. Under reservoir development, this area would be used for housing and recreation.[3]

---

* In reviewing the record for benefit and cost information, the staff has been guided by the "Principles and Standards"[2] and the received economic theory of benefit and cost measurement as appropriately cited.

** Water supply benefits are not discussed in the text because they are neither large nor controversial.

BENEFITS AND COSTS OF ALTERNATIVES

If the river development option is chosen, TVA proposes to participate in the establishment of 1,500 acres of high-value fruit and vegetable crops to be marketed in the Chattanooga and Knoxville markets. By positing 73 vegetable farms and 60 dairy farms, TVA can show substantial agricultural benefits for the river option.

Small benefits accrue to forestry in each alternative. Much lower benefits are shown if the land is used for less intensive beef and dairy farming. This less intensive farming establishes the lower bound on the agricultural estimates.

In addition, TVA believes that the earlier stages of development in the intensive agricultural scenario would provide jobs for unemployed workers. Thus TVA is able to claim an additional benefit.[4]

TVA's resulting annual equivalent agricultural and forestry benefits for the reservoir and river development options are:[5]

	Reservoir Development	River Development
Agriculture and Forestry	$0.11 million	$0.99 - 1.92 million
Wages to Unemployed	---	1.07 million
TOTAL	$0.11 million	$0.99 - 2.99 million

Some commenters express skepticism about the prospects for developing the vegetable and fruit enterprises. In response, TVA has indicated that it recognizes the risk and has expressed a willingness to achieve intensive development through conditions attached to deeds and leases and through technical assistance and farm credit.[6]

DOI has expressed doubts that all of the agricultural benefits are national benefits, because an increase in fruit and vegetable farming in Tellico will mean a decrease in these outputs in other farming regions.[7]

BENEFITS AND COSTS OF ALTERNATIVES

In accounting for the benefits of increased agricultural production, the water resource agencies conventionally ignore this problem as well as the existence of artificially high farm prices and the public costs of agricultural surpluses.[8]

TVA posits about a 100-percent difference in agriculture benefits between its upper and lower bounds. The committee thinks that a 50-percent improvement is reasonable and so posits an upper bound of $1.5 million net agricultural benefits. (Some commentors estimate net returns to intensive dairy farming of $7-8 million.[8a])

The issue of taking credit for wage payments to the otherwise unemployed is problematic. Such practices are not accepted under the Principles and Standards. However, it is acceptable in economic theory to reduce costs by the amount of payments to unemployed resources.[8b] We believe TVA has a claim in this instance and add $0.5 million for a total of $2 million in agriculture benefits. As to the other flaws mentioned above, it seems unwarranted to single out TVA for standard, albeit erroneous, procedures.

POWER GENERATION

The power production benefits from the Tellico Project are achieved by using a connecting canal between the Tellico and Fort Loudoun reservoirs to create one large pool for power generation. The availability of the Tellico water will enable the Fort Loudoun generators to generate an additional 200 million kilowatt hours (kWh) per year. However, this electricity will not be available as peaking power -- it does not add to the capacity of the TVA system. If the energy from Tellico were not available, this electricity would be produced at coal-fired and nuclear generating plants in the TVA system. The benefits of the energy from Tellico are the savings from not having to operate these other plants. These cost savings are the equivalent of 1.35

cents per kWh. TVA's resulting benefit estimates are:[9]

	Reservoir Development	River Development
Power Generation	$2.7 million	$0

No substantial objections have been raised to the TVA analysis of the power benefits. However, TVA has not made it clear that only operating expenses (and not capacity costs) have been used in calculating the alternative costs of Tellico power. The committee staff has checked the 1977 operating costs for a range of coal-fired TVA plants (0.81-1.39 cents) and nuclear plants (0.30-0.54 cents) and concluded that, by taking full allowance for future costs of emission controls and for increases in the relative price of coal and nuclear fuel, TVA can justify its claim to benefits.[10] The committee staff thinks that TVA's power benefits, which equal the 1977 cost of purchased power, are the maximum allowable.*

FLOOD CONTROL

The Tellico project would add 126,000 acre-feet of flood detention capacity during the prime flood control season in an "area of least present control."[11] The principal contribution of this storage would be to reduce flood damages in Chattanooga. TVA's calculations of benefits are:[12]

	Reservoir Development	River Development
Average Annual Flood Damage Reduction	$1.04 million	$0

---

* Although no power generation plans have been included in TVA's river development, some commentors have suggested that solar energy or cogeneration features could be incorportated into the river development alternative, so that this alternative would yield some net power generation benefits.[10a]

Although there is no reason to doubt TVA's technical competence at flood benefits analysis, commentors voiced some doubts about the validity of TVA's conclusions in the August 1978 draft. The committee staff has received similar comments on the record.[12a] The comments concern:[13]

- The incremental value of Tellico flood storage in reducing peak floods at Chattanooga by 4.8 inches
- The adequacy of attention to the alternative of flood plain management
- The effect of a decision by Chattanooga in March 1972 to relax their flood zoning ordinance.

The staff has investigated these issues and come to the following conclusions:

1. Without knowledge of TVA's flood frequency and stage-damage curves, we can only generalize that a 4.8-inch reduction in peak floods may be worth several millions of dollars. The flood benefit estimates are not based on a single flood but on all the floods that might be experienced without the reservoir.

2. The alternative of flood plain management is very likely to receive more attention in conjunction with river development and might reduce net flood damages.

3. Chattanooga's decision to relax the flood zoning ordinance may have affected the estimated flood benefits slightly, but the city will still maintain control over planning and development within the 2,600 acres under the regulations of the Flood Insurance Act.

4. TVA's decision to raise its minimum draw-down level reflects increasing technical ability to manage its storage reservoirs for multiple outputs and probably does not entail a sacrifice of ability to control floods.

The committee staff adopts TVA's estimate of flood damage reduction of $1.04 million as the maximum difference between the reservoir and the river alternatives.

BENEFITS AND COSTS OF ALTERNATIVES

LAND ENHANCEMENT

Once either alternative is developed, TVA proposes to sell land for housing. The value of the housing is assumed to benefit from the development of a lake for recreation and navigation in the case of reservoir development, or from a carefully planned and controlled river development.[14] Specifically, TVA estimates benefits at:

	Reservoir Development	River Development
Land Enhancement	$0.34 million	$0.4 million

Reservoir development enhances land values.[15] However, since the increase in land values is principally based upon access to free or nonmarketed recreation, if the benefits of that recreation are accurately estimated, then taking credit for land enhancement over and above the recreation benefits amounts to double counting.[16]

Similar arguments apply in the case of navigation benefits and industrial land enhancement. For this reason and because TVA acknowledges a lack of confidence in their estimates of demand for homesites in the river development alternative, the committee staff believes that the land enhancement benefits attributed to the alternative projects can be disregarded as a separate category of benefits.

RECREATION

The methods of estimating recreation benefits in TVA's latest studies have been recognized as great improvements over their earlier work.[17] The methodological problems that have had to be solved in developing the recreational estimates include: (1) accounting for the net increase in recreational use from adding one more reservoir to a

system of numerous reservoirs; (2) applying analytical estimates of the willingness to pay for recreation; (3) accounting for differences in the growth in future demand and in the availability of substitutes for river and reservoir recreation; and (4) overcoming the paucity of supply and demand data for riverine recreation.[18]

TVA estimates the recreation benefits of the reservoir and river development as $2.1-2.5 million for reservoir development and $2.4-3.1 million for river development. The differences in estimates reflect a lower growth rate in demand and a lower estimation of uniqueness for reservoir development compared to river development. DOI accepts TVA's range of values for the recreation benefits of the alternatives.[19] The committee staff prefers the upper limits of the ranges reflecting growth rates of 7 percent and 5 percent in river-based and reservoir-based recreation, respectively, and greater rather than lesser differences in uniqueness.*

Although TVA attempts to do so, it is doubtful if cultural, archaeological, and historical values can be quantified for the National Economic Development (NED) account.[21] We have chosen to discuss those values as an unmeasured benefit.

More than one commentor noted that Tellico Lake is almost certain to be infested with water milfoil and hydrilla, both noxious aquatic weeds.[22] The recreation benefit estimates do not account for this possibility.

---

* The TVA report includes a special report on fishing that separately attributes benefits of $1.4 million to development of the recreational fishery of the river. Fishing is included in the general estimates of the recreation benefits of river development.[20] (See discussion under unmeasured benefits for more on the river fishery.)

BENEFITS AND COSTS OF ALTERNATIVES

They assume acceptable quality in the recreation opportunities of both the river and reservoir alternative.*

NAVIGATION, EMPLOYMENT AND INCOME

Navigation, employment, and income benefits are primarily driven by TVA's industrial development scenarios, although agriculture and tourism also contribute to employment and income. TVA's industrial development scenarios have been criticized by Haveman,[23] who suggests that causal connections are missing, and by DOI[24] and the Conservation Foundation.[25]

TVA explains that its development scenario is based on selecting the high-growth national industries that could locate in the TVA region and then identifying the potential for shipping inputs and products of these industries by barge. Since none of these industries is now located in the Tellico area, TVA acknowledges that the navigation benefits could vanish in the vagaries of industrial location decisions. TVA's estimated benefits, therefore, are:[26]

	Reservoir Development	Accelerated Reservoir Development	River Development
Navigation benefits	$0-541,000	$0-620,000	$0

---

* The staff assumes that TVA includes the costs of water weed control in their annual operating and maintenance cost estimates for the reservoir. TVA has had long experience with water weed control as attested by their environmental impact statement of 1972.[22a]

BENEFITS AND COSTS OF ALTERNATIVES

DOI believes that the navigation benefits are zero.[27]* The staff believes that navigation benefits of about $100,000 would be correct.

Employment and income benefits are based on the industrial development scenarios. These benefits are regional rather than national in nature and therefore are not generally counted in the national economic account.[28] However, they are important from a regional and local viewpoint and are discussed in the TVA report. TVA's scenarios result in the following estimates of primary and secondary jobs and income generated by the industrial, agricultural, forestry, recreational, and cultural sectors after 10 and 25 years of accelerated development:[29]

	Reservoir Development	River Development
10 Years After Development		
Jobs	2,675	3,025
Annual Wages	$33.2 million	$28.9 million
25 Years After Development		
Jobs	8,235	8,695
Annual Wages	$103.5 million	$87.0 million.

* Several comments go so far as to question the fundamental tenet that navigation development induces economic development and cite statistics that the fastest growing counties in Tennessee are those without any TVA navigation development.[29a]

The vagaries of industrial location make these estimates subject to large errors. However, TVA reports that local commitment, which is an important factor in local development, has been received for whatever project option is finally chosen.[30]

Local unemployment can be a criterion for giving weight to employment and wage effects. TVA reports that unemployment in the project area is about 10 percent, while the state average is only 6-3/4 percent.[31]

On the matter of current unemployment, an official of the Tennessee Department of Employment Security cites unemployment rates for January-November 1978 of 5.9 percent for Loudon County and 8 percent for Monroe County. The staff has ascertained that the unemployment rate for Blount County for the period is 5.6 percent. The comment continues with the observation that "an unemployment rate of 6 percent indicates the area has a moderate labor shortage."[32] The lack of evidence of serious unemployment in the area weakens the argument that the project will satisfy a pressing need for jobs. On the other hand, if we can accept TVA's argument for allowing some small employment benefits for agricultural development, then the industrial development attributed to the project deserves some credit. We find it significant that TVA reports slightly more jobs for river development than for reservoir development.

UNMEASURED BENEFITS AND COSTS

Benefit/cost methodology permits measurement either from market prices, as in the case of flood control, power, navigation, and agricultural benefits, or from simulated market prices as in the case of recreation, fish, and wildlife benefits.[44] Some benefits and costs cannot be measured by any existing methods; nonetheless, these benefits are important and must be accounted for. Included in this category are effects on cultural, archaeological, and historical resources of the Tellico and Little Tennessee river valleys. Loss of existing fish and wildlife recreation is also partially in this category because the netting of these losses against recreation benefits created by the development plans only partially accounts for the income equivalent of the loss of current recreation opportunities by those enjoying them.[45]

BENEFITS AND COSTS OF ALTERNATIVES

The project would permanently inundate most of 280 archaeological sites that have been nominated to the National Register of Historic Places and 7 sites already on the Register. These sites represent a variety of human adaptations during the last 10,000 years to the environment of the Little Tennessee. The reservoir also would partially flood one national landmark site and one other National Register property, both of which have been elevated onto landfills.[46]

TVA has recovered and documented information and archaeological material from some of these sites. The Principal Investigator of the Tellico Archaeological Project states that no other river valley in eastern Tennessee has been as systematically investigated as the Little Tennessee. He also suggests that, since they have been investigated, inundation of these sites may be preferable to continued destruction of them by vandals and natural forces.[50]

The significance of flooding these sites is best conveyed in a memorandum from the principal chief of the Eastern Band of Cherokee Indians, who recites the history of the Cherokee in this valley.[47] An historian adds:

> ...[T]he overall riverine setting is very important to the understanding of [the Indians'] relationship to nature and their total way of life. This lifeway cannot be adequately portrayed in a lakeshore setting especially when the focal point, the council house, would be essentially surrounded by water.[48]

Another comment broadens the concern to the esthetic of the valley:

> ...[A]nyone who has but a little imagination and has ever walked the [Little Tennessee] valley south of the [Highway 411] bridge knows what I mean by saying "uniqueness." For it is in this part of the valley that one can most fully appreciate the high intensity of scenic and cultural character traits that make this river environment so ideally adapted and exciting for preservation and restoration[49].

BENEFITS AND COSTS OF ALTERNATIVES

Certain fish and wildlife values relating to the customary uses of the riverine and terrestrial wildlife habitat that would be inundated by the reservoir are not fully accounted for in the comparisons of measured recreation benefits. The Tellico Fisheries Evaluation Task Force counts in the "superlative nature of this river," temperature, flow, substrate, diversity and abundance of life present and the mineral and chemical quality of the water present.[51] The task force attempts to define a value based on willingness to pay for preserving and enhancing the trout fishery. Unfortunately, this value cannot be added to the willingness to pay estimates of the benefits for recreational development of the river because the latter include the trout fishery.

Another approach suggests that willingness to pay estimates cannot fully evaluate the losses to those who now enjoy the valley for recreational and esthetic experiences because these losses are measured by equivalent loss of income, not by expenditure. We do not propose to measure the "willingness to sell" of the present users, only to observe that its existence diminishes, by some unmeasured increment, the recreational benefits of the reservoir development in comparison with the river development.[52]

Yet another unmeasured value is the uncompensated effect of displacement of residents from the reservoir area and the offsetting gains to other property owners and the benefiting communities. One commenter reminds us that "[the project] has ruined my existence as a farmer and taken away my lifetime heritage" but is also mindful of the promise of "jobs and a higher standard of living [for] our community."[53] Reservoirs also have amenity values, as attested by the attractiveness of homesites on or near lakes. Commentors have described the potential beauties of the lake, and the enchantment of lakefront living.[53a]

REGIONAL DEVELOPMENT

Up to this point, the analysis has been concerned with national economic development effects. In addition, "Through its effects...a plan may exert a significant

influence on the course and direction of regional development."[54] Regional effects differ from national effects: national effects are net changes in the national economic (or recreational or environmental) accounts, while an effect in one region on employment or income is usually offset by an equal and opposite effect in the other regions of the nation.[55] It is conceivable, however, that national policy would favor efforts by the federal government to increase employment and incomes in certain regions at the expense of the other regions.

CAPITAL COSTS

TVA estimates the remaining capital costs of the reservoir project as $35.2 million for reservoir development and $22.5 million for river development.[56] A major item in both estimates is the completion of highway projects and historical restorations common to both projects. The cost of removing the earthen dam for river development is placed at $5 million. A major item in reservoir cost is $14.5 million to enable spillways to handle a larger maximum flood than was anticipated in the original design.

The resulting annualized capital costs (amortized over 50 years at 6-5/8 percent interest) plus operating, maintenance, and replacement (OM&R) costs are:

	Reservoir Development	River Development
Capital costs	$2.43	$1.55
OM&R costs	.76	.71
Total annual costs	$3.19 million	$2.26 million

BENEFITS AND COSTS OF ALTERNATIVES

OPPORTUNITY COSTS OF PROJECT LAND

Substantial controversy has been generated over the potential alternative of liquidating the acres of project land and over the related issue of correct treatment of sunk costs. The uses foregone on the land required for a water resource project are always counted as a cost of the project -- usually at market value.[33]

TVA prefers to view the land costs as sunk costs in the analysis of both options.[34] However, one of the commentors argues that the funds spent for land, roads, and bridges would be useful even if the dam were never closed and that if the land could be sold, then sunk costs would be reduced by the amount of the land sales.[35] DOI objects to TVA's treatment of the private-use value of the land as sunk cost and argues that the value of the land is "an opportunity cost which must be counted against any benefits attributed to public development."[36] The Director of the U.S. Water Resources Council states that the appropriate comparison based on a "without the project" condition should be the return of the land to the private sector.[37]

Leonard Shabman emphasizes this point in an extensive comment on land costs, in which he asserts that "the with and without comparison is fundamental to planning conducted under the [Principles and Standards]. While the Tellico report does note that the land would have an alternative use without any TVA plan, it does not properly consider the value of land in the without project condition in its analysis of alternatives."[38]

TVA maintains that the costs of the land are sunk and liquidation of the land is not a desirable alternative because it "would not assure the potential for land and water resource development inherent in the large land base now held by TVA."[39] However, TVA's view on the desirability of liquidation does not settle the argument over whether or not the alternatives of reservoir or river development are immune to comparisons of the value of the lands in private hands. TVA estimates the private value of the project lands as anywhere from "$18 to $20 million to a high of $40 million or more."[40]

BENEFITS AND COSTS OF ALTERNATIVES

The committee staff obtained data on bare agricultural land sales in Loudon and Blount counties for the last 2 years from the Louisville office of the Federal Land Bank. Loudon County sales ranged from $650 per acre to $2,500 per acre, with an average of $1,467. Blount County sales ranged from $561 per acre to $2,950 per acre, with an average of $1,211. TVA categorizes project acreage as prime farmland, land of statewide agricultural importance, and undesignated. Assigning an average value of $2,500 per acre to prime land, $1,400 per acre to land of statewide agricultural importance and $650 per acre to undesignated land gives a total agricultural market value of project lands in excess of $43 million. Actual private use would involve industrial and agricultural development of part of the land, which would generally sell at higher prices than agricultural land.

The private value of the lands may be based on some uses that would be inimical to the snail darter, to public recreation, or to historical and cultural value. With this in mind, DOI suggests tha the true value of the land is its market value reduced by public control measures and public ownership designed to protect the snail darter and other values.[42] TVA has indicated that either alternative would involve private purchase or leasing of certain project lands.[43]

The committee staff believes that an adjusted market value of $40 million is consistent with these considerations, and that this value must be treated as a relevant cost in evaluating the public development alternatives. Calculating the annual equivalent cost of the land at the private discount rate of 10 percent rather than the public discount rate of 6-5/8 percent, the annual cost of the land is $4.03 million over a 50-year period.[43a] The measurable development benefits net of capital costs for both TVA alternatives are therefore less than the value of private land uses foregone. Neither alternative can be justified on economic grounds alone. Both options generate substantial unquantifiable benefits, however, which must be weighed in deciding whether either is acceptable as it stands.

Comparison of private land value with public development implicitly identifies total or partial liquidation as a third alternative to the two TVA development options.

BENEFITS AND COSTS OF ALTERNATIVES

Both DOI and Shabman discuss an alternative involving a combination of public and private land ownership that captures many of the recreation, cultural, esthetic, and species preservation benefits of the river alternative as well as the benefits of private land ownership. Shabman tentatively calculates annual benefits of $1.09 million in excess of land costs for this plan. The committee staff believes that this alternative is worthy of further TVA investigation.

HISTORIC COST

The capital costs represent the incremental costs of completing the project as of December 1978. By the end of February 1977, TVA had spent $103 million as follows:[57]

Land Costs		
Purchase price	22.1	
Related costs	3.4	
		25.5
Construction		
Dams	22.5	
Roads, bridges & utilities	35.7	
Other	4.8	
		63.0
Planning and Engineering		14.7
TOTAL		103.2 million

In August 1978 , TVA estimated total costs of the project at $130.3 million (in 1978 dollars), of which $21.3 million remained to be spent.[58] To this sum would now be added $14.5 million for additional spillway work for a total of $144.8 million, of which $35.2 remains to be spent.

Exhibit 3

Benefit Cost Summary
National Economic Development Benefits
(in millions of dollars annual equivalent)

	Reservoir Development			River Development		
	TVA	**DOI**	**CS***	**TVA**	**DOI**	**CS**
Benefits						
Land enhancement	0.34	0.34	———	0.04	0.04	———
Flood control	1.04	1.04	1.04	———	———	———
Navigation	0.00-0.62	0.00-0.62	0.10	———	———	———
Power	2.70	2.70	2.70	———	———	———
Recreation	2.10-2.50	2.10-2.50	2.50	2.40-3.10	2.40-3.10	3.10
Water supply**	0.045	0.045	0.045	———	———	———
Agriculture and forestry	0.11	0.11	0.11	0.99-2.99	0.99-2.00	2.00
Total Benefits	**6.34-7.36**	**6.34-7.36**	**6.52**	**3.43-6.13**	**3.42-5.14**	**5.10**
Capital costs†	3.19	3.19	3.19	2.26	2.26	2.26
Opportunity cost of land††	0.00	1.14-2.03	4.03	0.00	1.14-2.03	4.03
Total Costs	**3.19**	**4.33-5.22**	**7.22**	**2.26**	**3.40-4.29**	**6.29**

SOURCES TVA, Tellico Project; DOI, Views.

* Denotes committee staff.

** Water supply benefits are based on savings in pumping costs (TVA report, p. 107).

† In all cases, TVA's estimates of capital costs, including operating and maintenance costs, have been accepted.

†† The discount rate on CS land costs is 10 percent. On all other categories, the WRC discount rate of 6 5/8 percent has been used.

BENEFITS AND COSTS OF ALTERNATIVES

TOTAL NET BENEFITS

The committee staff estimates the total monetized benefits of reservoir development at $6.50 million annually; the benefits of river development total $5.10 million. Capital, operating, and maintenance costs total $3.19 and $2.26 million respectively. The opportunity costs of the project land -- $4.03 million for either project -- bring total costs to $7.22 and $6.29 million. Obviously, measured costs exceed measured benefits for either project. We do not draw a bottom line here, because that would involve weighing the unmeasured benefits in each case. Also, the comparison between alternatives is crucial to the deliberations of the committee and is not to be overshadowed by conclusions about the economic worth of either project.

Exhibit 3 provides a summary of the measured benefits and cost of the two alternatives.

REFERENCES

1. Endangered Species Act of 1973, as amended, section 7(h)(1)(A)(ii).

2. "Principles and Standards," Federal Register 38 (No. 174), Part III: 24778-24869.

3. Tennessee Valley Authority, Alternatives for Completing the Tellico Project (December 1978), Appendix A, Table 2, p. 98.

4. Tennessee Valley Authority, Tellico Project, Appendix A, p. 101. See also the discussion on p.___ and ___.

5. Tennessee Valley Authority, Tellico Project, pp. 33-34; Appendix A, pp. 97-103.

6. Tennessee Valley Authority, Tellico Project, pp. 93-94.

7. Department of the Interior, David Hales, Assistant Secretary of the Interior for Fish and Wildlife and Parks, Views and Recommendations to the Endangered Species Committee, letter (January 8, 1979) to the Committee Chairman, pp. 13-14.

8. Otto Eckstein, Water Resource Development (Cambridge, Massachusetts: Harvard University Press, 1958), pp. 200-201; Davis, et al., in Joint Committee Print, 92nd Congress, 2nd Session, pp. 82-95.

8a. Comment by Daniel Burgner, August 29, 1978; unsigned comment, January 8, 1979.

8b. Robert Haveman and John Krutilla, Unemployment, Idle Capacity and the Evaluation of Public Expenditures: National and Regional Analysis (Baltimore: Johns Hopkins Press, 1968), p. 87ff.

9. Tennessee Valley Authority, Tellico Project, pp. 29-30; Appendix A, pp. 104-106.

10. DOE/EIA, Steam-Electric Plant Construction Costs and Annual Production Expenses 1977, Thirteenth Annual Supplement, December 1978 and FERC/OEPR Hydroelectric Power, January 1979.

10a. Comments by Daniel Burgner (August 29, 1978) and William Chandler (January 8, 1979).

11. Tennessee Valley Authority, Tellico Project, p. 108.

12. Tennessee Valley Authority, Tellico Project, pp. 28-29.

12a. Comments by Linda Melgaard (January 8, 1979); C.J. Mellor (January 8, 1979); Kirk Johnson (January 6, 1979).

13. Tennessee Valley Authority, Tellico Project, pp. 56-59; comments in the record by Kirk Johnson (to Jane Parker, October 1, 1978) and Carrol M. Waddle (to Jane Parker, September 19, 1978).

14. Tennessee Valley Authority, Tellico Project, p. 28.

15. Jack L. Knetsch, "The Influence of Reservoir Projects on Land Values," Journal of Farm Economics (February 1964): pp. 231-243.

16. Marion Clawson and Jack L. Knetsch, Economics of Outdoor Recreation (Baltimore: Johns Hopkins Press, 1968), p. 224.

17. Comment by the Conservation Foundation (to David Freeman and Robert Herbst, September 25, 1978), p. 10.

18. Tennessee Valley Authority, Tellico Project, Appendix A, pp. 109-115.

19. Department of the Interior, Views.

20. Department of the Interior, Views; Tennessee Valley Authority, Tellico Project, pp. 31-32, 77-86.

21. Department of the Interior, Views; comment by the Conservation Foundation, p.___.

22. Comments by Charles Powell (January 8, 1979); C.C. Amundsen (January 8, 1979); Zygmunt Plater (January 10, 1979).

22a. Tennessee Valley Authority, Control of Eurasian Watermilfoil (Myriophyllum Spicatum L.) in Tennessee Valley Reservoirs, TVA-OHES-EIS-72-8 (September 29, 1972).

23. Comment by Robert Haveman (to David Freeman and Robert Herbst, September 27, 1978).

24. Department of the Interior, Views.

25. Comment by the Conservation Foundation, p. ___.

26. Tennessee Valley Authority, Tellico Project, pp. 29, 117-118.

27. Department of the Interior, Views, p.___.

28. "Principles," p. 24816.

29. Tennessee Valley Authority, Tellico Project, Table 3, p. 39; pp. 118-122.

29a. Comments by George E. Speva (January 8, 1979) and E. Bruce Foster (January 8, 1979).

30. Tennessee Valley Authority, Tellico Project, p. 66.

31. Tennessee Valley Authority, Tellico Project, p. 66.

32. Comment of William Gary Kilzer, Tennessee Department of Employment Security (no date).

33. "Principles," p. 24807.

34. Tennessee Valley Authority, Tellico Project, p. 26.

35. Comment by the Conservation Foundation, p. 13; comment by Trout Unlimited (to Jane Parker, September 26, 1978).

36. Department of the Interior, Views, p. ___.

37. Comment by Leo Eisel (to Cecil D. Andrus, January 9, 1979).

38. Comment by Leonard Shabman (to Cecil Andrus, January 8, 1979).

39. Tennessee Valley Authority, Tellico Project, p. 46.

40. Tennessee Valley Authority, Tellico Project, p. 34; $18 to 20 million represents the purchase price in 1966-1967.

42. Department of the Interior, Views, p. 12.

43. Tennessee Valley Authority, Tellico Project, p. 48.

43a. Eckstein, Water Resource, p. 146.

44. See American Geophysical Union Water Resource Monographs by Charles Howe, Benefit Cost Analysis for Water System Planning, 1971, and Jack L. Knetsch, Recreation Benefit Analysis, ___, for current statements of benefit cost methodologies and the limits of measurement.

45. Dwyer, Kelly, and Bowes, Improved Procedures for the Valuation of the Contribution of Recreation to National Economic Development (Urbana, Illinois: University of Illinois, Water Resources Center, June 1977).

46. Department of the Interior, Views.

47. Letter and memorandum from Chief John A. Crowe (to David Freeman, September 29, 1978).

48. Comment by Herbert L. Harper, Executive Director, Tennessee Historical Commission (to David Freeman, September 29, 1978).

49. Comment by Will Morgan (to Cecil D. Andrus, January 5, 1979).

50. Comments by Alfred K. Guthe (to David Freeman, September 29, 1978; to Cecil Andrus, January 5, 1979).

51. Tennessee Valley Authority, Tellico Project, pp. 78-88.

52. See Judd Hammack and Gardner Brown, Wetlands and Waterfowl (Baltimore: Johns Hopkins Press), who demonstrate the willingness to sell the concept and attempt to measure it.

53. Comment by J.C. Hitch (to Jane Parker, September 20, 1978).

53a. Comments by Charles Hall, Mayor of Tellico Plains, in Transcript of Hearing (Knoxville, January 8, 1979) and Lloyd M. Watkins (January 10, 1979).

54. "Principles," p. 24816.

55. Cicchetti, et al., "Evaluating Federal Water Projects: A Critique of Proposed Standards," Science, 181 (August 24, 1973): 724-772.

56. Tennessee Valley Authority, Tellico Project, pp. 40-42.

57. General Accounting Office Report, pp. 5-8.

58. Tennessee Valley Authority, draft report (August 10, 1978), Table 1, p. 112.

CHAPTER 3

CONSISTENT WITH THE PUBLIC INTEREST

In granting an exemption, members of the Endangered Species Committee are required to ascertain that the proposed action is in the public interest (Section 7(h)(1)(A) (ii)).

> To be in the public interest, an agency action must affect some interest, right or duty of the community at large in a way which they [sic] would perceive as positive.[1]

It is clear that many people in the community directly affected perceive the project positively. A letter from nine members of the Tennessee Congressional Delegation reports on a poll of the Second Congressional District (counties of Blount, Campbell, Claiborne, Knox, Loudon, McMinn, Monroe, Scott, and Union). People were asked:

> The Tellico Dam is 95 percent complete. Some people advocate that the dam not be completed and the project changed to recreation and other purposes. Do you favor completion as originally proposed?

Of the 13,046 persons who responded, 82 percent voted yes, 14 percent voted no, and 4 percent remained undecided.[2]

Nonetheless, a community of interests opposes the project. The Little Tennessee River Alliance, which has actively opposed the Tellico project over the last 5 years, claims a Tennessee membership of its affiliates in excess of 24,000 persons plus the Eastern Band of Cherokee Indians. The Alliance finds ample justification for not completing the project.[3]

In the final analysis, the public interest is determined by weighing the measured and unmeasured benefits and costs of the proposed action and its alternatives and by considering who receives the benefits and who pays the costs.

REFERENCES

1. Conference Report on the 1978 Amendments to the Endangered Species Act, p. 20

2. Letter (Jan. 2, 1979) from the Hon. John J. Duncan, et al., to Cecil D. Andrus. The poll consisted of a "postal patron" mailing -- no names were used -- of a questionnaire with 15 questions, including the Tellico question, to every household with a mailbox in the district, totalling 190,000 households. No newsletter was attached. Respondents payed postage. Results were tabulated by Public Opinion Research Corporation.

3. Submission (Jan. 10, 1979) from Zygmunt J.B. Plater to Cecil D. Andrus.

CHAPTER 4

THE SNAIL DARTER

The Tellico project was halted because it posed a threat to the survival of the snail darter in the lower Little Tennessee River. In reaching a decision on the Tellico case, the committee must consider the esthetic, ecological, educational, historical, recreational and scientific value of the species and the risk of extinction.

The values are difficult to evaluate. As the snail darter was only discovered in 1973, there is still much we do not know about its biology. Although recent studies are reliable, earlier statements were based on incomplete information.

To assist the committee in resolving these issues, we have conducted a review of available information. On the basis of that information, it appears that the snail darter is an ecologically unique, endangered species that is very sensitive to ecological perturbation. Moreover, the snail darter has some esthetic, scientific, and ecological value.

In the following pages, we present the discussion of the snail darter in two sections:

- Biological and ecological characteristics of the snail darter
- The value of the snail darter.

BIOLOGICAL AND ECOLOGICAL CHARACTERISTICS OF THE SNAIL DARTER

Although biologically similar to other darters, the taxonomy, geographical distribution, and habitat, food, and reproduction requirements of the snail darter establish it as an ecologically unique species.

THE SNAIL DARTER

Taxonomy

The snail darter, a member of the perch family, is one of five closely related species in the genus Percina, subgenus Imostoma.[1]

When the FWS originally proposed listing the snail darter as an endangered species, formal publication of its description and taxonomy had not appeared in the scientific literature.

Publication of the description of Percina tenasi[2] establishes the species status of the snail darter. This status implies that this taxonomic entity is reproductively isolated from all other populations and thus represents a unique evolutionary lineage.[3]

Geographical Distribution

The snail darter is restricted to the lower reaches of the Little Tennessee River. Larval fish drift downstream into the Watts Bar Reservoir on the Tennessee River, but self-sustaining populations do not occur there. After a period of development in the slower, deeper waters of the Tennessee River, yearling fish migrate back upstream to their preferred habitat. If this migration does not occur, the population as a whole will not survive.[4] Although some ichthyologists believed that the snail darter would, upon proper search, be found in other appropriate areas,[5] an extensive search by TVA biologists failed to reveal any other snail darter populations. The population in the lower Little Tennessee therefore appears to be the only one extant.[6]

It has been proposed that the former range of the snail darter included the upper reaches of the main channel of the Tennessee River and lower reaches of the river's major tributaries, and that human alteration, especially impoundment of the drainage, has led to restriction of the species distribution.[7] The absence of the species from apparently appropriate habitats in tributaries to the lower Tennessee River would tend to support this hypothesis. However, the species may have been excluded from those areas by ecological rather than historical factors. Attempts to establish transplanted snail darter populations into similar areas in

other Tennessee River tributaries can test the hypothesis that the fish has been excluded from those areas by historical biogeographic factors.

In summary, the critical habitat of the snail darter, in fact, its entire range, lies within the area that will be flooded if the Tellico Project is completed. There appears to be no serious disagreement that the snail darter is appropriately listed as an endangered species under the Endangered Species Act of 1973.

Habitat, Food, and Reproduction Requirements

The snail darter is a true specialist with respect to habitat, food, and reproduction requirements.[8] Species with such narrow ecotopes are nearly always very sensitive to environmental perturbation. This means that not only may disruption of the present habitat of the fish lead to extinction, but potential sites for transplanted populations must be chosen with great care.

To survive within its limited range, the fish needs areas of shallow (0.5-1.5m) water with swift current over shoals of sand, gravel, and rubble. The species apparently requires cool, highly oxygenated water of high quality.[9] Siltation of the benthos in the area of the shoals caused by dams would presumably jeopardize the survival of the species.

The diet of the snail darter is also highly specialized and differentiates the species from other similar species in its habitat. This factor allows the species to coexist with at least three similar species (two darters, *P. evides* and *P. caprodes* and a sculpin, *Cottus carolinae*). The snail darter (*P. tenasi*) has a unique position in the food web associated with the gravel shoal habitat of the lower Little Tennessee. While the cogeneric species *P. evides* and *P. caprodes* share a wide range of prey species, largely insects, *P. tenasi* derives most of its diet from snails that play little or no role in the diets of the associated species.[10]

SNAIL DARTER

The timing of reproduction also distinguishes the snail darter from other darters. Although actual mating has never been observed, the snail darter clearly spawns very early in the year (February-April), unlike other darters which spawn in spring and summer. Perhaps because of this early spawning, larvae develop slowly.[11]

Despite some effort on the part of TVA biologists and biologists at the University of Tennessee, no darters have been induced to spawn in captivity. Furthermore, no fertilized snail darter larvae -- either from eggs collected from the field or from eggs artificially fertilized in vitro -- have yet been reared to adulthood. All captive larval fish have died.[12]

VALUE OF THE SNAIL DARTER

The Conference Committee specified that "benefits" shall include ecological considerations and that the Endangered Species Committee should consider "esthetic, ecological, educational, historical, recreational and scientific value of any endangered or threatened species."[13]

Ecological Value

Our knowledge of the structure and function of ecosystems, although developing rapidly, is sketchy. Consequently, it is difficult to assign an ecological value to the snail darter. Nonetheless, one may comment on its probable relative importance within its own system in the basic ecosystemic processes: energy flow, nutrient cycling, and ecosystem regulation. In addition, the contribution of the snail darter to species diversity can be considered.

Energy Flow. As a rare species of limited distribution, the snail darter has only a limited role in the productivity and flow of energy in the ecosystem it inhabits.

Nutrient Cycling. Once again, the low numbers of snail darters probably preclude their importance in the cycling of nutrients. On the other hand, a mussel

population, which played a minor role in energy flow and which comprised only a small amount of the biomass in the system, was found to play a very important role in cycling the nutrient phosphorous in a salt marsh ecosystem.[14] The specialized food habits of the snail darter and its unique position in the food web suggest that the species may be important in this regard. The development of young fish downstream and later migration back to the gravel shoals area must play some role in returning nutrients from downstream.

Ecosystem Regulation. The snail darter is likely to play an important role in ecosystem regulation; fluctuations in its population appear to be tied to that of the species of snails upon which it feeds.

Contribution to Species Diversity. Assessment of ecological value beyond the limited, immediate ecosystem may be difficult. Many ecologists hold that biological diversity per se has ecological value because it induces stability or resilience in ecosystems.[15]

The snail darter may contribute to ecological diversity by virtue of its specialized habits. It may also contribute to genetic or evolutionary diversity because it represents a unique store of genetic information.

Esthetic Value

Esthetic value is perhaps the most difficult to assess. Knowledge of the snail darter's highly selective food habits and habitat choice makes the species interesting and gives esthetic pleasure to some people.

Ironically, the controversy surrounding the snail darter has drawn attention to and developed interest in its biology, thus probably increasing the species' esthetic value. There may be a higher esthetic value to preserving the species in its natural environment than maintaining it in artificial environments.

SNAIL DARTER

Education Value

Before the present controversy, the snail darter was generally unknown. As it becomes more widely known, its educational value will increase. For example, its case has already been used in the classroom.

Historical Value

As it was discovered only in 1973, the snail darter has no present historical value. On the other hand, we can assume that the present controversy will eventually have significant historical value. Some of this value may accrue to a preserved snail darter by virtue of the species' central role in the controversy. This value would probably not be significantly changed by preserving populations only in artificial environments.

Recreational Value

At present, the snail darter has little or no recreational value other than its existence as an object to be known and studied. The popularity of nature in the mass media and the guided biological travel tour testify to the recreational value of natural species in general and to the potential of the snail darter.

Scientific Value

Access to natural populations of snail darters is of some value to biologists. Although it is impossible to foresee all potential scientific interests to which such populations may contribute, some are clear. Studies of the systematics and evolution of darters and other percid fish will be enhanced by access to natural populations of snail darters. The ecological uniqueness of this species makes it a potentially interesting subject for ecological studies of the process by which natural communities are organized. Artificial populations, because of their greatly altered ecology and genetic makeup, will probably have less scientific value than the population in the Little Tennessee.

REFERENCES

1. Etnier, D.A., "Percina (Imostoma) tanasi, a new percid fish from the Little Tennessee River, Tennessee," Proceedings of the Biological Society of Washington, (1976), Vol. 88, pp. 469-488.

2. Etnier, (1976); Letter (Feb. 16, 1976) from E. Raney to the Director, Fish and Wildlife Service.

3. Mayr, E., Animal Species and Evolution (Cambridge Mass.: Harvard University Press, 1963).

4. Ricklefs, R.E., Ecology (Newton, Mass.: Chiron Press) pp.751ff.

5. Letter from E. Raney to FWS.

6. Tennessee Valley Authority, Alternatives for Completing the Tellico Project (December 1978).

7. Wayne C. Starnes, The Ecology and Life History of the Endangered Snail Darter, Percina (Imostoma) Tanasi Etnier (Knoxville, Tennessee: University of Tennessee, March 1977); TVA, Tellico Project, p. 133.

8. Starnes, Darter.

9. Starnes, Darter.

10. Starnes, Darter.

11. Starnes, Darter.

12. Starnes, Darter.

13. Conference Report on the 1978 Amendments to the Endangered Species Act, p. 20.

14. Teal, J.M., "Energy Flow in the Salt Marsh Ecosystem of Georgia," Ecology 43: 614-624.

15. Walter E. Westman, Bioscience 28 (1978): 705.

CHAPTER 5

IMPACT OF DEVELOPMENT ALTERNATIVES ON THE SNAIL DARTER

In evaluating its options -- grant an exemption, grant an exemption with mitigation measures, deny an exemption -- the committee must consider the effect of each option and the ensuing development alternative on the continued survival of the snail darter. If the committee grants an exemption with or without stipulating mitigation measures, TVA has the option of proceeding with reservoir development. If no mitigation measures are stipulated, the snail darter would probably become extinct. If the committee grants an exemption with mitigation measures, the survival of the snail darter would still be uncertain. It appears that denial of exemption, which would probably prompt TVA to pursue some form of river development, is the only option likely to favor the continuance of the snail darter. This conclusion concurs with the findings of the Snail Darter Recovery Team.[1]

In the following sections, we discuss the implications of alternatives, including proposed mitigation measures, for the continued survival of the snail darter.

RIVER DEVELOPMENT

With the river development option, removal of the earthen dam now blocking the north channel would eliminate the threat posed by the continued presence of the dam.

There may be some danger from vegetation removal. Although past vegetation removal for agricultural and other activities has not destroyed the fish's habitat, severe watershed alterations accompanying changes in land use could cause erosion and pollution problems.[2] Consequent siltation and eutrophication in the lower Little Tennessee would adversely affect the critical habitat of the snail darter.

IMPACT OF ALTERNATIVES ON THE SNAIL DARTER

The "river development" alternative is a surrogate for a wide variety of alternative uses of the land including a range of public/private ownership arrangements. The specific river development alternative evaluated by TVA may not compare favorably, in terms of measurable economic benefits and costs, with returning the land to private ownership. Of course, all of TVA's future actions regarding the land it now owns (including selling the land) must comply with applicable federal laws, including Section 7 of the Endangered Species Act.

With river development, DOI would proceed to adopt a recovery plan. TVA, the Wildlife Resources Agency, and the Fish and Wildlife Service would bear the costs.

RESERVOIR DEVELOPMENT

Reservoir development would "eliminate the only habitat known to be suitable to snail darters" and, unless successful mitigation or recovery operations are performed, would lead to extinction.[3] Reservoir development is consequently discussed only in conjunction with the recommended mitigation and recovery measures.

DOI has proposed that the following mitigation measures found in the draft recovery plan for the snail darter[3a] be adopted in conjunction with completion of the reservoir:[4]

> 1. Delay closure of Tellico Dam 1-3 years to allow continued monitoring of transplanted snail darter populations into the Hiwassee and Holston rivers and any other river in which darters have been transplanted as a result of selection by TVA in consultation with the Tennessee Wildlife Resources Agency (TWRA) and the FWS.

IMPACT OF ALTERNATIVES ON THE SNAIL DARTER

2. Increase the range of the snail darter by selecting one or two additional rivers for transplanting. These actions would be carried out by TVA in consultation with and with the assistance of the FWS and TWRA. The following actions would be required:

a. Identify transplanted sites within the historic range of the species by TVA at an approximate cost of $75,000.

b. Monitor Hiwassee and Holston River transplant populations to evaluate population dynamics. Continue monitoring Hiwassee River populations to determine if population levels are adequate to provide for future transplant stocks and then transplant. Transplant populations must then be monitored.

These actions would be carried out by TVA at an approximate cost of $115,000 for the siting studies and transplants and $25,000 per year for monitoring.

3. Rescue snail darters from the Little Tennessee River and transplant into selected rivers. Rivers thus far selected are the Hiwassee and Holston rivers. This work would be done by TVA at an approximate cost of $45,300.

4. Preserve transplanted populations in the Hiwassee, Holston, and other rivers. Preservation activities would include monitoring population dynamics and identifying factors that have the potential for influencing these populations. These actions would be carried out by TVA and the TWRA at a one-time cost of approximately $18,000 by TVA and $10,000 annually by TVA and TWRA.

5. Conduct studies and carry out actions to identify the necessity for determining transplant sites as Critical Habitat. This will be carried out by TVA, TWRA, and FWS. Any final determination of Critical Habitat would be carried out by the FWS.

IMPACT OF ALTERNATIVES ON THE SNAIL DARTER

6. Develop propagation techniques for hatching and rearing snail darters in captivity. TVA would develop these propagation techniques at an approximate cost of $27,300.

7. After propagation techniques have been developed, the FWS would then undertake continued propagation and stocking of darters at an approximate production cost of $30 per 1,000 fish.

If the mitigation measures are adopted to offset completion of the reservoir, the following problems must be recognized:

1. The long-term success of the transplants cannot be assured. The FWS has stated that 5-15 years will be required to demonstrate the permanent viability of these populations, and even this estimate may be optimistic. Populations are subject to environmental forces, some of which operate stochastically on long-time scales. The present apparent health of the Hiwassee population says little for long-term survival. Even after 15 years, unusual changes in water temperature or in water level, or any of a host of unusual events could lead to the loss of these populations. The view that the snail darter has been excluded from the Hiwassee and other areas by historical rather than ecological factors is merely a reasonable hypothesis; the species may have been eliminated from those habitats by ecological forces of which we are now ignorant.*

2. Populations of fish derived from transplanted stock, because they are a small and possibly erratic sample of the population, will bear only a portion of the genetic information contained in the gene pool of the natural population. This decrease in genetic variability will probably

---

* One biologist studying the snail darter states that "the Holston River cannot be considered a viable habitat until proven otherwise."[5]

lessen the ability of the population to adapt to environmental changes. This alteration of the gene pool means that the transplanted population is not the same evolutionary entity as the Little Tennessee population in its natural habitat.

3. All attempts to rear larval snail darters to maturity have failed. It may be impossible to develop techniques for rearing the fish in 3 years' time at the estimated cost of $30 per 1,000 fish. Even if the techniques could be developed, the desirability of these techniques is not proven.

4. The mitigation and enhancement recommendations require monitoring population size and dynamics of either the natural population, the Hiwassee and other transplant populations, or both. All methods for estimating the size of animal populations involve considerable uncertainty.[6]

REFERENCES

1. Tennessee Valley Authority, Alternatives for Completing the Tellico Project (Dec. 1978), App. C, p. 168.

2. See various publications by Likens, Bormann, et. al., especially Ecology Monogram.

3. Comment of David Etnier (January 8, 1979).

3a. TVA Tellico Report App. C, pp. 128-168

4. Department of the Interior, Assistant Secretary of the Interior for Fish, Wildlife and Parks, Views and Recommendations to the Endangered Species Committee (Jan. 8, 1979).

5. Comment of Wayne C. Starnes (Jan. 9, 1979).

6. Wayne C. Starnes, The Ecology and Life History of the Endangered Snail Darter, Percina (Imostoma) Tanasi Etrier (Knoxville, Tennessee: University of Tennessee, March 1977), p.7ff.

Errata p. 2.15

The fifth sentence from the top of page 2.15 should read as follows: Assigning an average value of $2,500 per acre to prime land, $1400 per acre to land of statewide agricultural importance and $650 per acre to undesignated land gives a total agricultural market value of project lands in excess of $43 million.